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(71) Applicant *(for all designated States except US)*: ABB FLÄKT AB [SE/SE]; S-120 86 Stockholm (SE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)* : BERGSTRÖM, Åke [SE/SE]; Tärbygatan 3c, S-745 62 Enköping (SE).

(74) Agents: MODIN, Jan et al.; Axel Ehrners Patentbyrå AB, Box 10316, S-100 55 Stockholm (SE).

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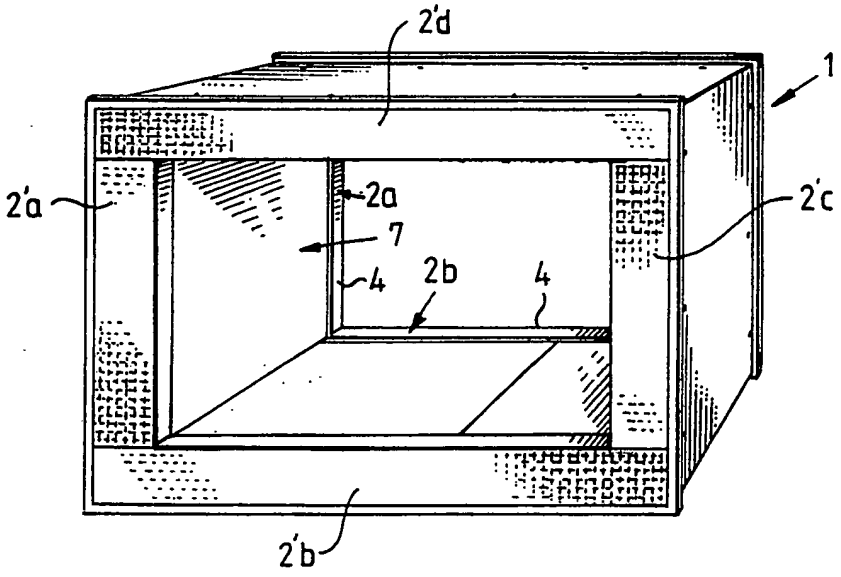
(54) Title: INSULATED VENTILATION DUCT COMPONENT AND METHOD OF PRODUCING THE SAME



(57) Abstract

An insulated ventilation duct component having at least two connection openings for coupling to other components in a ventilation installation is disclosed. The duct component, comprising an external metal sheet casing (1), an internal insulating material layer and an internal metal sheet coating, forms a unitary, stable and fire isolating unit. The external and internal metal sheet casings are mutually connected by means of one ore more perforated metal sheet elements (2a etc., 2'a etc.), which cover the corresponding end surface of the insulating material layer (6a etc.) and which has a reduced capacity of conducting heat between the inside and the outside of the duct component by way of the perforations.

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Insulated ventilation duct component and method of producing the same

The invention concerns an insulated duct component with at least two connecting openings for coupling to other components in a ventilation installation, said duct component comprising an external metal sheet casing enclosing the component all around, a layer of insulating material disposed inside the metal sheet casing, and an internal metal sheet coating. The invention also concerns a method of producing such a duct component.

Ventilation ducts are often insulated in order to prevent the transfer of heat to the surrounding, so that e.g. heated supply air in a supply air duct will not cool down, or cooling air will not be heated. It is also desireable to maintain the heat contents in exhaust air in case of an exhaust duct being connected to a heat exchanger, where the heat carried by the exhaust air is normally transferred to the outdoor air, which is blown in through a supply air duct. Heat insulation of ventilation ducts is also essential from the point of view of fire hazard, and hot flue gases or flames should be conducted through a duct without causing a fire in the surrounding construction members in a building.

The most common way of insulating ventilation ducts is to install a metal sheet duct system consisting of straight duct sections, bends, branches, dimensional shifts, sound dampers and other components, whereupon an insulating material is brought on externally, either in the form of mats or layers being laid onto the ducts and fastened in a suitable manner, e.g. by means of a threaded net, or in the form of preformed insulating bodies, e.g. tubular sections.

Such mounting of insulating material is normally made largely at the site of the installation, which requires much work and

time and is consequently rather costly, in particular at joints and couplings of various kinds.

It also well known to provide the inside of metal sheet ducts (in particular rectangular ducts) with insulating layers and to cover the insulating layers internally with loose metal sheets. This can be made in advance in a manufacturing plant, but the making of holes and the like for the connection of branch ducts or the like is made very difficult because the insulating layers and the associated loose metal sheets will easily be cut off and fall into separate pieces. Thus, problems often arise at the installation site.

The object of the present invention is to eliminate the above mentioned problems and to provide an insulated duct component, which is easy to mount and which does not require time consuming work at the site of installation.

This object is achieved in that the duct component and the associated layer of insulating material and the internal metal sheet coating form a unitary, stable and fire isolating unit, wherein the internal metal sheet coating is likewise made up of a metal sheet casing being closed all around, and wherein the external and internal metal sheet casings at the respective connection openings are mutually connected by means of one or more perforated sheet metal elements, which cover the corresponding end surface of the layer of insulating material and which, because of its perforations, has a reduced capacity of conducting heat between the inside and the outside of the duct component.

The expression "a metal sheet casing being closed all around" is intended to mean that the internal metal sheet coating covers the layer of insulating material internally all over and is open only in the region of the connecting openings of the duct component. Normally, the internal metal sheet casing

is formed as an internal shell, which is uniform with the external metal sheet casing.

Thus, the internal and external metal sheet casings with the intermediate layer of insulating material form a sandwhich-like element, the stability of which is enhanced by the connection of the perforated metal sheet elements in the region of, i.e. all around, the respective connection openings. The metal sheet elements will be located esentially in the plane of the connection opening and will form a spacing means for the edge portions of the metal sheet casings radially outside the connection opening. Such spacing means of a suitable heat resistant material, i.e. in practice a metal material, would normally form heat conducting bridges radially between the inside and the outside. By means of the perforated sheet metal elements, however, the heat conductivity can be reduced to such values which are acceptable from the point of view of fire hazard.

The degree of perforation and hole configuration should be selected so as to achieve a desired fixation of the layer of insulating material at the end surfaces thereof in the end region radially outside the associated connection opening (which is important i.a. when storing, transporting and handling of the duct component), and to reduce the heat conductivity of the metal sheet element radially to the necessary extent (between the inside and the outside).

In practice, it has turned out to be favourable to use substantially square holes and a degree of perforation of about 70%. Other configurations and degrees of perforation may be considered, in particular in accordance with any one of the claims 4 - 7.

The invention is especially suitable for ventilation ducts having a rectangular cross-section, although it can of course be used also for ducts having circular or other cross-sectio-

nal forms. In case of rectangular ducts, the metal sheet elements associated with a connection opening will preferably be constituted by four straight metal sheet profile elements disposed along an associated one of the four side edges of the opening. Each such metal sheet profile element may preferably have a substantially U-shaped cross-section with inner and outer flange portions which are fastened, e.g. by means of spot welding or special fasteners, to the internal or the external metal sheet casing, respectively, and an intermediate, perforated web portion extending between the inside and the outside of the duct component. Compare the claims 2 and 3.

The strength requirements are not as severe for the internal metal sheet casing as for the external metal sheet casing, since the latter will be more likely to be exposed to mechanical strain at transport and installation. Preferably, at least the internal metal sheet casing can be produced in a simple manner by bending a piece of metal sheet into a closed cross-section with overlapping edge portions, which are mutually secured by means of a double adhesive tape. Such a sheet metal casing, being denoted "duct component", is described in detail in a simultaneously filed patent application ("Ventilation duct component and a method of producing the same"), the contents of which are included into this application by reference. Compare also claim 8.

When manufacturing a ventilation duct component according to the present invention, one starts out from the external metal sheet casing, or a substantial portion thereof, and provides the same with one or more layers of insulating material located inside thereof, i.e. in the form of sheets of isolating material, whereupon the internal metal sheet casing is applied, e.g. by application or insertion through a connection opening. Thereupon, the layer of insulating material and the external metal sheet casing is supplemented, if required, and the external and internal metal sheet casings are connected by

means of the perforated metal sheet elements in the region of the connection openings.

In case the duct component is made up of a straight section having a rectangular cross-section and a connection opening at each end thereof, the perforated metal sheet elements, associated with one connection opening, are preferably first secured to the external metal sheet casing, whereupon the layer of insulating material is applied, and thereafter the internal metal sheet casing is fixed to the already applied perforated metal sheet elements, whereafter, finally, the perforated metal sheet elements associated with the other connection opening are secured.

The invention will be explained more fully below with reference to the appended drawings, which illustrate two simple embodiments.

Figs. 1a, 1b, 1c, 1d and 1e illustrate in schematic perspective views how a straight duct component can be produced step by step in accordance with the invention; and

Figs. 2a, 2b, 2c, 2d, 2e and 2f illustrate in a corresponding way how a 90° duct bend can be manufactured in accordance with the invention.

In Fig. 1a there is shown a metal sheet casing 1, which is intended to constitute the external side of the finished duct component and which has a rectangular cross-section with side walls 1a, 1c and lower and upper walls 1b and 1d, respectively. The metal sheet casing is made of one unitary piece of metal sheet which has been bent along the longitudinal corner edges and has been fixed to a closed cross-section by means of a longitudinal joint (not shown). This longitudinal joint can be constituted by a folding joint or a tape joint, as described in the above mentioned patent application. Moreover, adjacent to the edges of the opposite connection openings, the

metal sheet casing 1 can be provided with flanges (not shown) for coupling with other duct components by means of slip joints and seals, so that a tight joint is formed in a manner known *per se*.

In this embodiment, the duct component is manufactured by first applying metal sheet profile elements 2a, 2b, etc. (see Fig. 1b) internally along one edge of the connection opening (the remote one in Figs. 1a and 1b), e.g. by spot welding. As appears from Fig. 1b one uses four straight metal sheet profile elements, one along each wall, 1a, 1b, 1c, 1d adjacent to the opening, each metal sheet profile element having a substantially U-shaped cross-section with flange portions 3, 4 and an intermediate perforated web portion 5. In the first manufacturing step according to Fig. 1b, the flange portions 3 are spot welded to the respective wall 1a, 1b etc., so that the remote connection opening in Fig. 1b is now defined by a perforated edge frame consisting of the four metal sheet profile elements 2a, 2b, etc.

Thereafter (see Fig. 1c), layers 6a, 6b, 6c, 6d of insulating material are laid inside the respecive metal sheet casing wall 1a, 1b, 1c, 1d, the remote end portions in Fig. 1c being fitted between the flange portions 3, 4 at the respective metal sheet profile element 2a, 2b, etc. A good fit will be obtained if the layers 6a, 6b, etc. of insulating material have a width corresponding to the respective length of the metal sheet profile elements 2a, 2b, etc.

As appears from Fig. 1d, an internal metal sheet casing 7 is then applied at the inside of the insulating material layers 6a, 6b, etc. This internal metal sheet casing has a closed cross-section, like the external metal sheet casing 1, with corresponding walls 7a, 7b, etc. and a longitudinal joint 7e. Preferably, the metal sheet casing 7 is dimensioned such that it can be fitted inside the internal flange portions 4 of the metal sheet profile elements 2a, 2b, etc. In this process, one

may cut a short slit in the respective flange portion 4 or in the metal sheet casing 7 in the region of each corner (compare the part 4a of the flange portion 4b), so that the flange portion 4 can be brought to overlap the metal sheet casing 7 adjacent to the connection opening.

Finally (compare Fig. 1e), corresponding metal sheet profile elements 2'a, 2'b, 2'c, 2'd are applied at the other connection opening (the hither one in Fig. 1e), the flange portions 3, 4 of these metal sheet profile elements being fixed at the inside by the internal and external metal sheet casings 1, 7 by means of separate fasteners, such as rivets or screws (since there is no room for spot welding in this case).

As appears from Fig. 1e, the finished duct component is totally coated with metal sheet internally and externally and has its connection openings framed by perforated metal sheet elements, the latter having several functions, viz.:

- they will hold the duct component together into a unitary, stable unit;
- they will serve as spacer elements for the internal and external metal sheet casings 1, 7 and will hold the latter at a well defined mutual distance while enclosing the layers of isolating material;
- they will protect the end surfaces of the insulating material layers 6a, 6b, etc. and will thereby prevent parts thereof to become loose and, in the worst case, to clog some other duct in the ventilation installation;
- because of the perforations they will secure a relatively low heat conductivity between the inside and the outside.

As mentioned above, the degree of perforation is preferably about 70%, but may in principle vary between 30% and 90%, preferably between 60% and 80%, in particular between 65% and 75%.

The hole configuration may also be modified from square openings to relatively longitudinal slits, which preferably extend substantially in parallel to the edges of the associated connection openings, so that the heat conduction between the inside and the outside is reduced as much as possible while maintaining the required stability and closure of the end surface of the insulating material layer.

In Figs. 2a - 2f there is illustrated how a 90° duct bend may be manufactured step by step in a similar manner as the straight duct according to Figs. 1a - 1e.

Thus, in this case, one starts out from an external shell or metal sheet casing 10 (Fig. 2a), which however is not completely finished (compare Fig. 2e, where the part 10′ has been added). Inside the metal sheet casing 10 insulating material layers 11 are mounted, as shown in Fig. 2b, whereupon an internal metal sheet casing 12 is applied (Fig. 2c). Thereafter, the insulating material layer 11 is supplemented by a quarter tube element 11′ (Fig. 2d) and the external metal sheet casing 10 is supplemented with a quarter tube portion 10′ (Fig. 2e), whereupon the edge portions of the connection openings A, B are finally covered and fixed by means of perforated metal sheet profile elements 12′a, 12′b, 12′c, 12′d and 12a, 12b, 12c, 12d, respectively, corresponding to the metal sheet profile elements 2a etc. and 2′a etc. in Figs. 1b and 1e.

Of course, other standard types of ventilation duct components can also be pre-manufactured in a similar manner within the scope of the invention according to the appended claims.

CLAIMS

1. Insulated ventilation duct component having at least two connection openings for coupling to other components in a ventilation installation, said duct component comprising an external metal sheet casing (1) being closed all around, a layer (6a etc) of insulating material located inside said metal sheet casing, and an internal metal sheet coating (7), c h a r a c t e r i z e d in that the duct component and the associated insulating material layer and the internal metal sheet coating form a unitary, stable and fire isolating unit, wherein the internal metal sheet coating is likewise constituted by a metal sheet casing (7) being closed all around, and wherein the external and internal metal sheet casings (1, 7) are mutually connected in the region adjacent to the respective opening by means of one or more perforated metal sheet elements (2a etc., 2'a etc.), which cover the corresponding end surface of the insulating material layer (6a etc.) and which has a reduced capacity of conducting heat between the inside and the outside of the duct component by way of their perforations.

2. Insulated duct component as defined in claim 1, wherein the respective connection opening is substantially rectangular, c h a r a c t e r i z e d in that said metal sheet element associated with a connection opening is constituted by four straight metal sheet profile elements (2a etc., 2'a etc.) arranged along each one of the four side edges of the opening.

3. Insulated duct component as defined in claim 2, c h a r a c t e r i z e d in that the straigth metal sheet profile elements (2a etc.) have a substantially U-shaped cross-section with inner and outer flange portions (4, 3), which are fastened to the internal and the external metal sheet casing (7, 1), respectively, and an intermediate, perforated web portion (5).

4. Insulated duct component as defined in any one of claims 1 - 3, c h a r a c t e r i z e d in that the degree of perforation in said metal sheet element is 30 - 90%.

5. Insulated duct component as defined in claim 4, c h a r a c t e r i z e d in that the degree of perforation is 60 - 80%, in particular 65 - 75%.

7. Insulated duct component as defined in claim 4 or claim 5, c h a r a c t e r i z e d in that the holes of said perforated metal sheet element are rectangular.

8. Insulated duct component as defined in any one of claims 1 - 7, c h a r a c t e r i z e d in that the internal metal sheet casing (7) consists of a piece of metal sheet being bent into a closed cross-section with overlapping edge portions, which are mutually fixed by means of a double adhesive tape.

9. A method of producing an insulated ventilation duct component having at least two connection openings for connection to other components in a ventilation installation, wherein an external metal sheet casing (1), which is closed all around, is provided with an internally disposed insulating material layer (6a etc.) and an internal metal sheet coating (7), c h a r a c t e r i z e d in that said internal metal sheet coating (7) is mounted as a metal sheet casing (7), which is closed all around, and in that the external and the internal metal sheet casings (1, 7) are mutually connected by means of perforated metal sheet elements (2a etc., 2'a etc.), so that the corresponding end surfaces of the insulating material layer (6a etc.) are covered and a unitary, stable and fire isolating unit is formed.

10. A method as defined in claim 9 for producing a straight ventilation duct component with rectangular cross-section and a connection opening at each end, c h a r a c -

terized in that one first applies the perforated metal sheet elements (2a etc.), which are associated with one of said connection openings, at the external metal sheet casing (1), that the insulating material layer (6a etc.) is mounted and the internal metal sheet casing (7) is thereafter mounted, which is fastened to the already applied perforated metal sheet elements (2'a etc.) and that the perforated metal sheet elements (2'a etc.) associated with the other connection opening are finally being fixed.

Fig. 1a

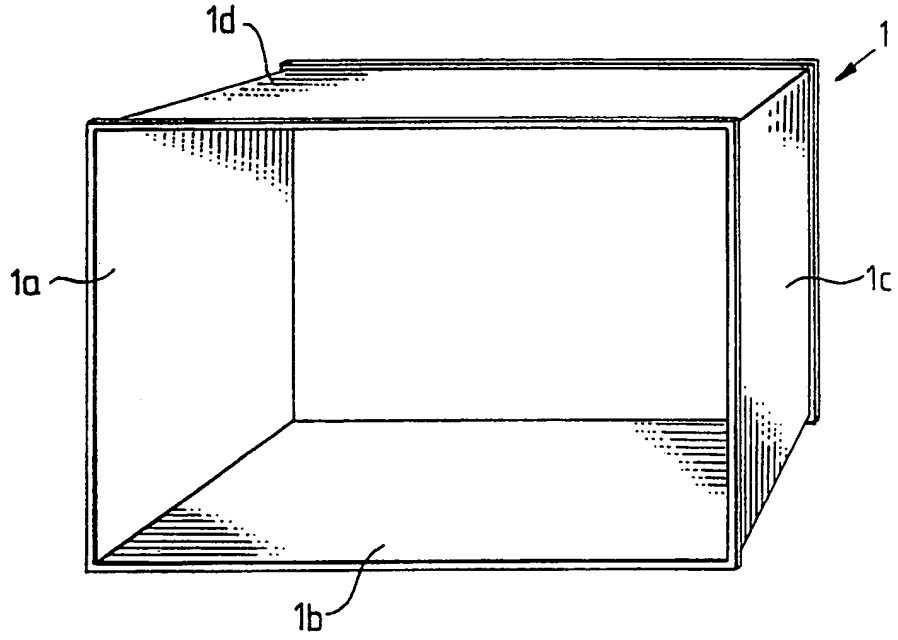


Fig. 1b

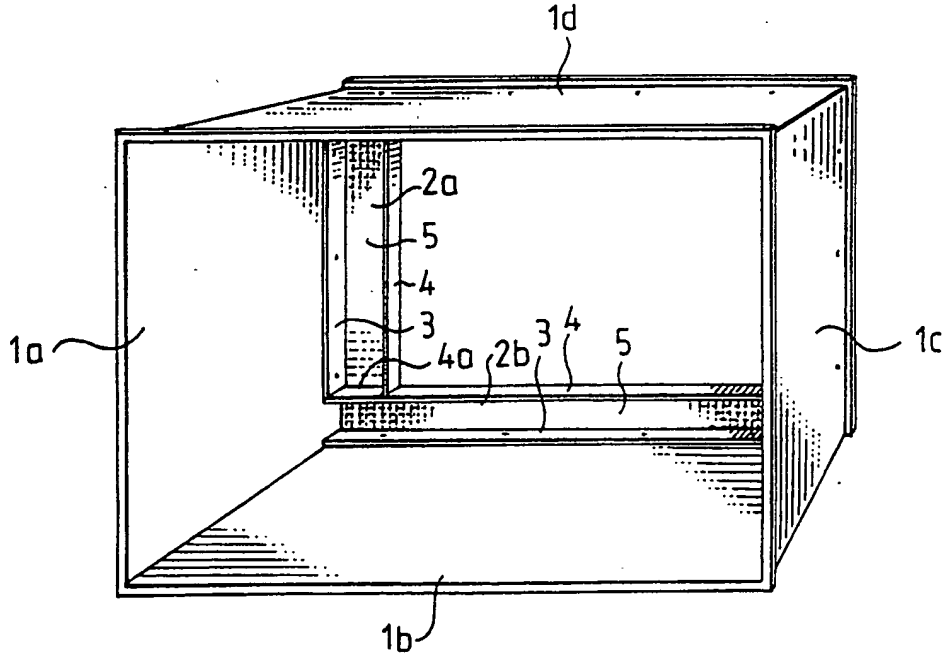


Fig. 1c

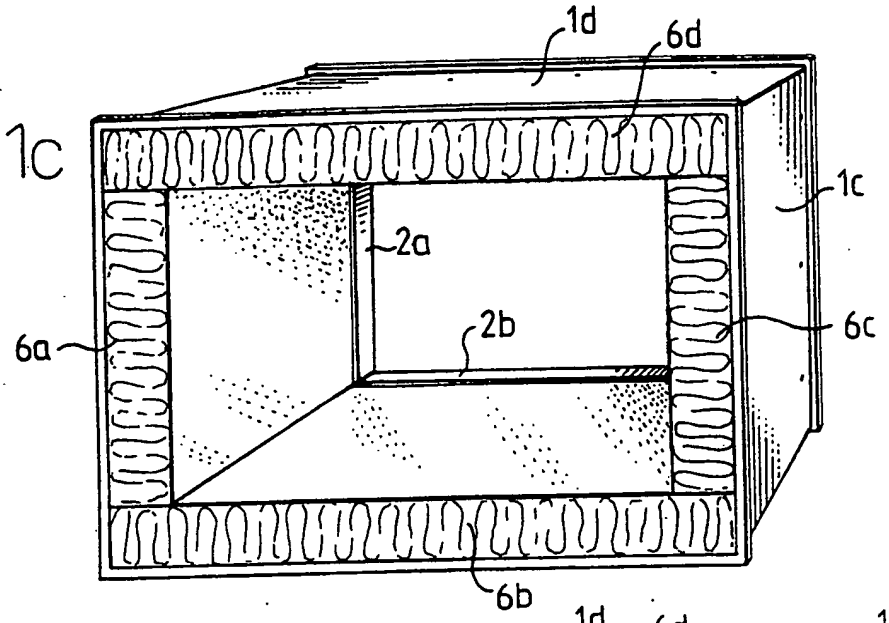


Fig. 1d

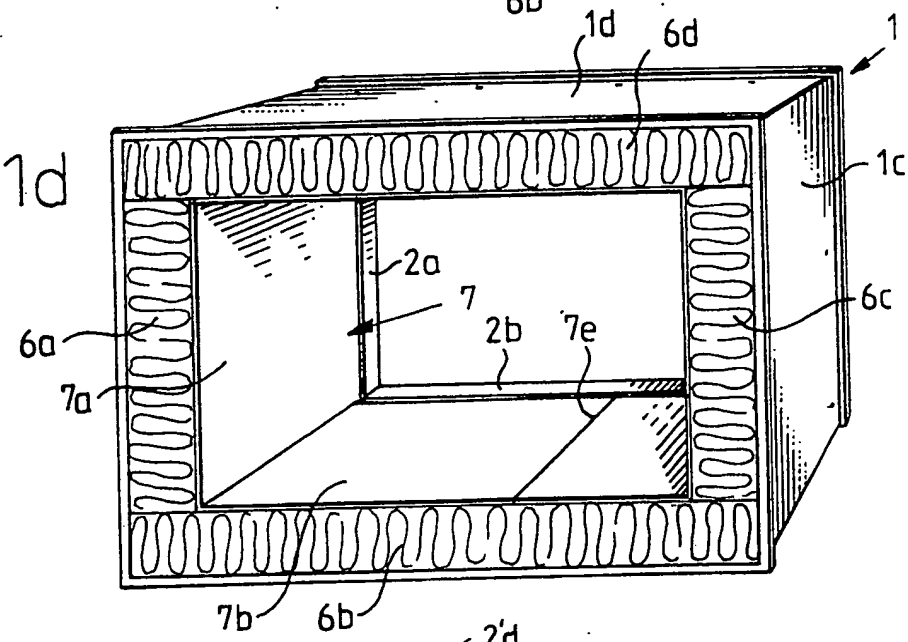


Fig. 1e

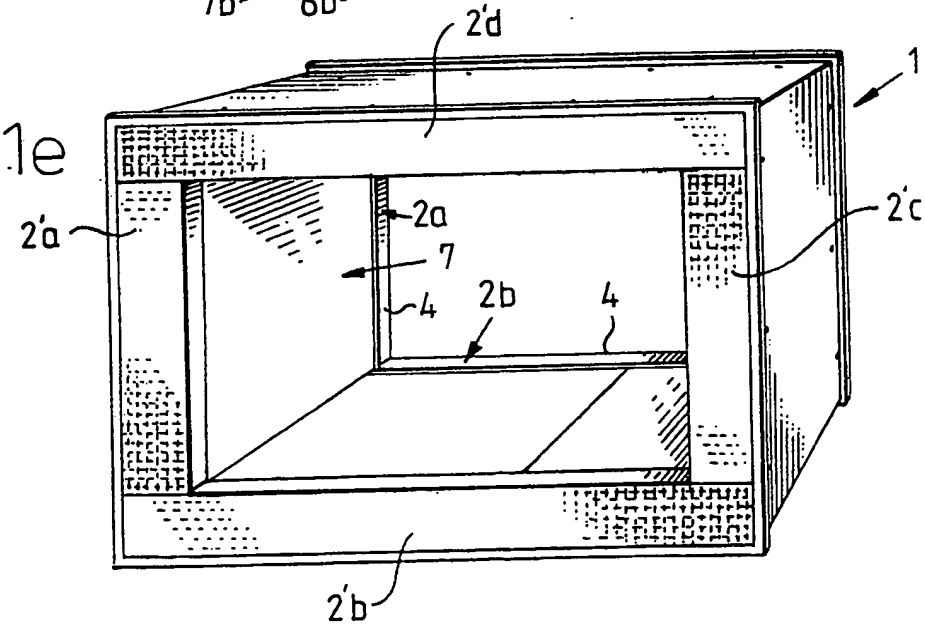


Fig. 2a

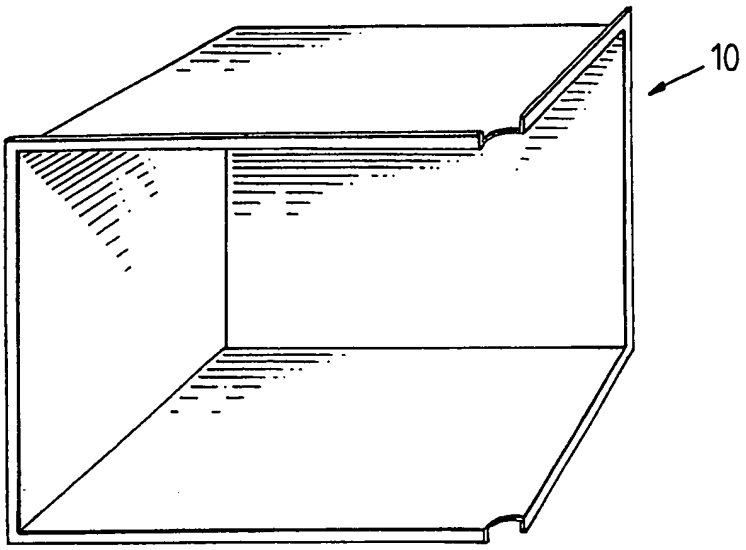


Fig. 2b

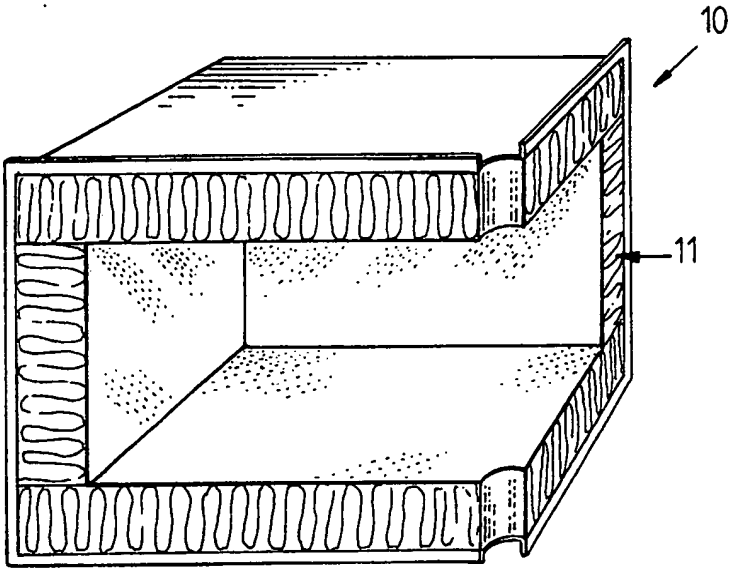


Fig. 2c

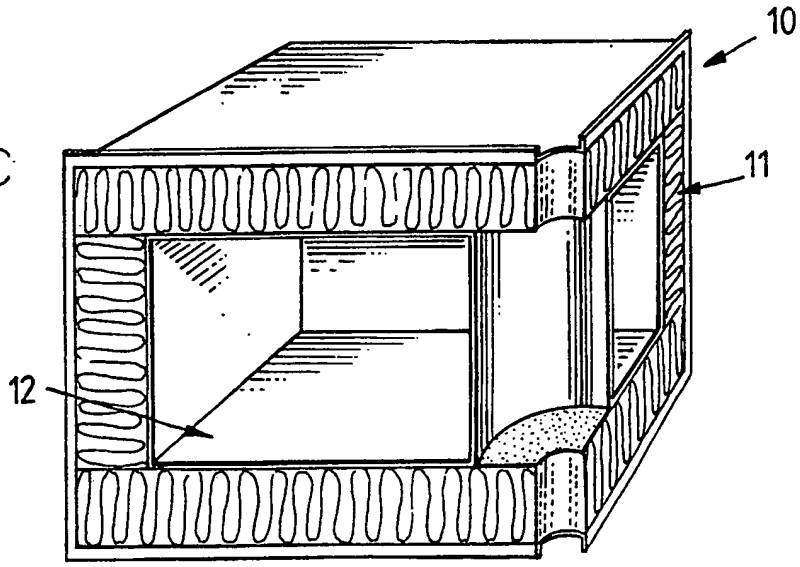


Fig. 2d

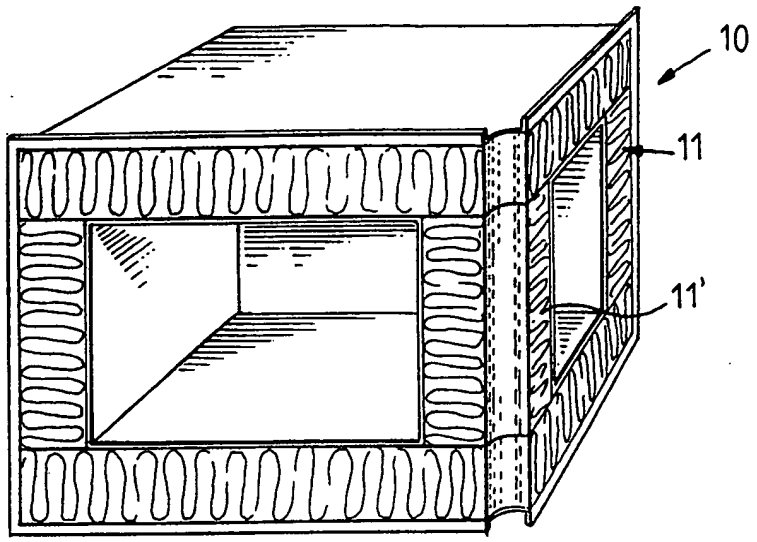


Fig. 2e

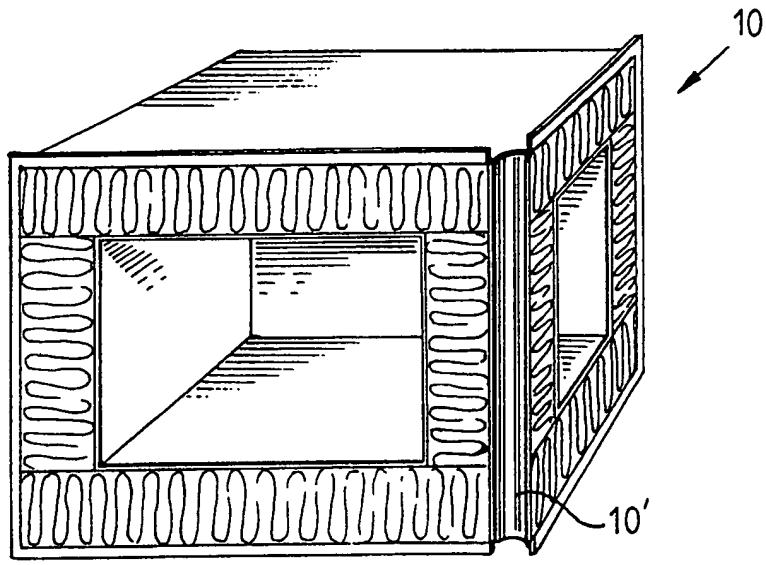
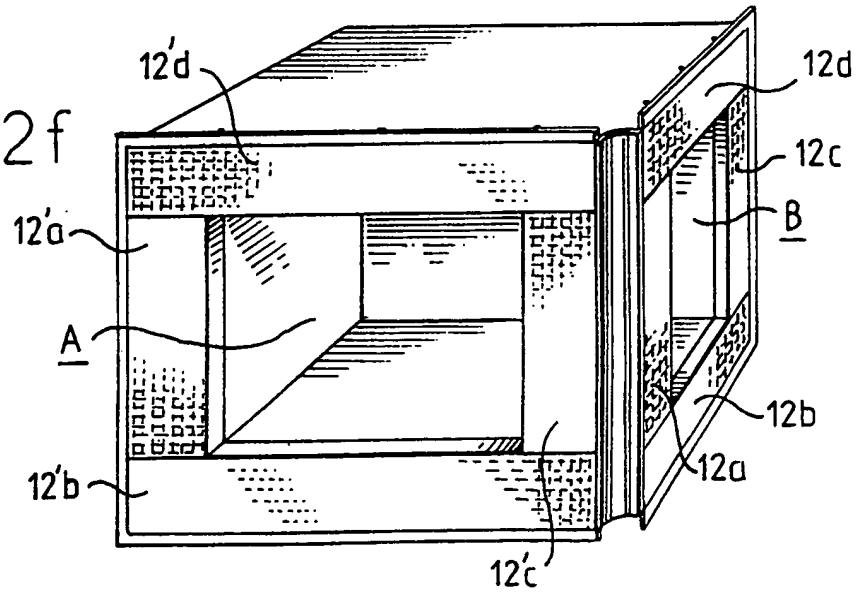


Fig. 2f



A. CLASSIFICATION OF SUBJECT MATTER

IPC5: E04F 17/04
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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category°	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SE, B, 372811 (PROMAT GESELLSCHAFT FÜR MODERNE WERKSTOFFE MBH & CO. KG), 13 January 1975 (13.01.75) --	1-10
A	DE, A1, 2718839 (I.P.U. LTD.), 2 November 1978 (02.11.78) --	1-10
A	DE, A1, 3925781 (STAUDACHER JUN., SEBASTIAN), 14 February 1991 (14.02.91) --	1-10

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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19 February 1992	08 -03- 1993
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US, A, 2108159 (W.J. BARMAN A), 15 February 1938 (15.02.38)	1-10

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DE-A1- 2718839	02/11/78	NONE	
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US-A- 2108159	15/02/38	NONE	